

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

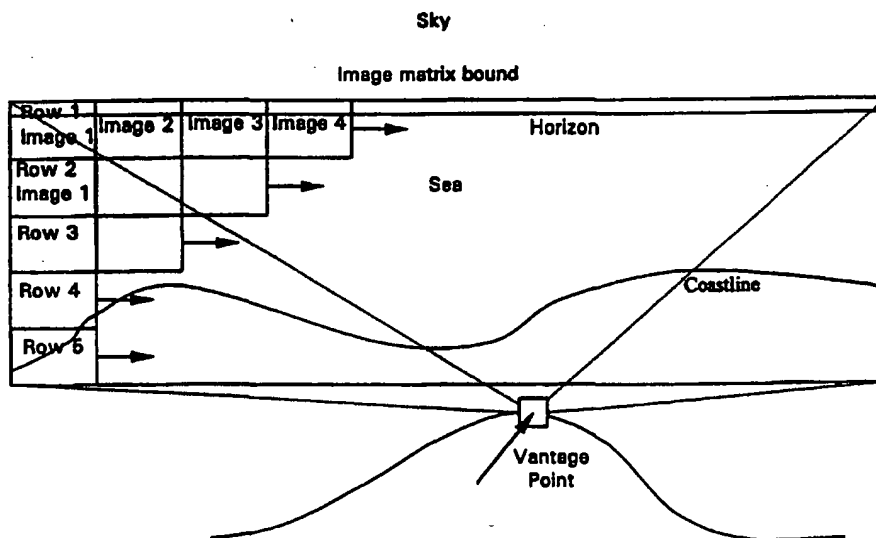


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G08B 13/194		A1	(11) International Publication Number: WO 99/21145
			(43) International Publication Date: 29 April 1999 (29.04.99)
(21) International Application Number: PCT/NZ98/00148			(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: 13 October 1998 (13.10.98)			
(30) Priority Data: 328997 20 October 1997 (20.10.97) NZ			
(71) Applicant (for all designated States except US): INDUSTRIAL RESEARCH LIMITED [NZ/NZ]; Brooke House, 24 Balfour Road, Parnell, Auckland (NZ).			
(72) Inventor; and			
(75) Inventor/Applicant (for US only): BEACH, Allan, David [NZ/NZ]; 786 South Titirangi Road, Titirangi, Auckland (NZ).			
(74) Agents: HAWKINS, Michael, Howard et al.; Baldwin Shelston Waters, NCR Building, 342 Lambton Quay, Wellington (NZ).			

Published
With international search report.

(54) Title: AN IMPROVED SURVEILLANCE SYSTEM



(57) Abstract

A surveillance system is described. The system includes an imaging means which scans a scene in a sequence or matrix of contiguous images. Each image is compared to a previously collected reference image which allows the system to gauge whether there is some form of activity, object or other triggering event occurring in the location. When such an event or visual occurrence is detected the system uses an imaging means (possibly a second or additional imaging means) to zoom in on the area or particular matrix in which the event has occurred. The image thus obtained may then be analysed to determine what type of activity or object has been detected in the particular matrix or image. The system can be used for surveillance of coastal regions, battlefields and other sensitive areas. An example of a suitable imaging means is a 200mm f/1 lens.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

An Improved Surveillance System

Technical Field

The present invention relates to improvements in and relating to surveillance systems. More particularly, although not exclusively, the present invention relates to surveillance systems for use in broad-spectrum applications and where both telephoto and wide-angle surveillance functionality is required.

Background Art

There are various instances where surveillance of a particular area may be required and various proposals have been put forward for this purpose. In the case of remote coastlines, there is an increasing need to be able to detect the intrusion into an area of sea of any unauthorised shipping, whether this be for coastguard purposes in detecting smuggling or in a defensive role in detecting possible invasion. Typically, in a marine situation, surveillance will be required over a specified area of sea, scanning the sea up to the horizon.

In a land based situation, the surveillance area could, for example, be a battlefield or a border zone, both of which requiring increasing levels of surveillance with the international reluctance to employ land mines to secure a particular area.

To the present time, it has been known to utilise high-resolution zoom lenses in order to identify an object of interest. However, such zoom lenses have various design constraints, including limited speed and spectral bandwidths which do not extend outside the visual red-green-blue spectrum, which constraints degrading the observational capacity at low light levels.

For example, in the case of a coastguard surveillance of a wide area of sea through an angle of perhaps 120°, there may be a need to identify suspect craft. Such craft may be only a few metres long at ranges of several kilometres and, indeed, of course, the craft may be presenting an even smaller width when coming into shore. In such circumstances, such craft may not be detectable in the wide-angle field of a zoom lens, whereas if the lens were

set to a telephoto mode, then the craft would only be detectable within a very narrow field angle.

The present invention provides for an imaging lens which in coastguard surveillance
5 has a long focal length and is very fast (preferably faster than $f/1$) for operation at low light levels and preferably with a spectral band pass extending into the infrared to allow spectral analysis. More specifically and in a preferred embodiment, the present invention utilises the KIWISTAR (Trade Mark) imaging system developed by the present applicant which is described, for example, in New Zealand Patent Specification Nos 236307 and 236308 and
10 International Specification No. PCT/NZ95/00051.

Numerous other situations, domestic, industrial, military or the like where surveillance of areas is required, will become apparent to those skilled in the relevant arts from the
15 following description.

It is, thus, an object of the present invention to provide a surveillance system which will overcome or at least obviate problems in surveillance systems available to the present time, or which at least will provide the public with a useful choice.
20

Further objects of this invention will become apparent from the following description.

25

Disclosure of the Invention

According to one aspect of the present invention, there is provided a surveillance system comprising:

- (i) an imaging means;
- 30 (ii) means for scanning an area under surveillance with said imaging means so that a matrix of contiguous images are obtained;
- (iii) means for detecting a first image within any of said contiguous images which may be inconsistent with an earlier collected first image; and

(iv) means enabling a specific focusing on an area proximate or corresponding to the first image.

Preferably, the imaging means comprises an ultra-fast high-resolution broad-spectrum
5 long focal length imaging system.

Suitably, a surveillance system as defined in either of the paragraphs immediately above, uses at least two imaging means, a first of which being utilised for scanning the required area and the second of which being used for focusing on a specific image.

10

According to a further aspect of the present invention, a method of providing surveillance for a required area includes providing at least one imaging means which provides a matrix of contiguous images over the required area and includes means for detecting a change in any one of said images requiring further investigation.

15

According to a further aspect of the present invention, there is provided a surveillance system and/or method therefor substantially as herein described.

Brief Description of the Drawing

20

Further aspects of this invention which should be considered in all its novel aspects will become apparent from the following description given by way of example of possible embodiments thereof and in which reference is made to the accompanying drawing which shows very diagrammatically a possible use of an embodiment of the invention in coastguard surveillance.

25

Best Mode for Carrying out the Invention

The present invention will be described particularly in respect of a coastguard surveillance system, but it will be appreciated by those skilled in the relevant arts that the present invention has application wherever surveillance of a particular area may be required.

30

In the accompanying drawing, one of possibly several surveillance means, a plurality of which could typically be located along a coastline and connected together to a central processing system, is shown very diagrammatically, referenced by arrow 1. This is

providing surveillance over a particular area of coastline to the horizon, and in doing so, is collecting a matrix of contiguous images which will then be stored, suitably in a large video memory, so that the images are being continually updated, awaiting some change to be detected. As indicated very generally, the scanning can be provided in the manner of a matrix of a number of images for each specified number of rows. It will be appreciated, however, that this is given by way of example only and it may be that the scanning could concentrate on particular areas where surveillance is especially needed and where smuggling or invasion, for example, could likely take place, whereas for other areas of the area under surveillance, images can be taken with lesser frequency.

It is envisaged that the visual memory of the area under surveillance may be suitably programmed so that what is normally present in an image at a particular time of day, a particular tide, a particular time of year, etc. is regarded as the normal image against which the most recent scanned image is then tested for any changes which may be detected.

Where such a change in a particular image is detected, then the imaging means may, it is envisaged, be commanded to stop scanning so that that area can be focused on and the suspect craft identified and suitably tracked. It is envisaged that the imaging means would have the capability of identifying the direction and speed of movement, if any, and may be able to identify a particular type of craft if that was desirable, particularly in a military surveillance system.

In a preferred embodiment of the present invention, at least a pair of imaging means may be provided so that one imaging means may be used for specifically focusing on an area or object found in that area while the other imaging means continues in scanning the overall area under surveillance.

In one example of the present invention, a KIWISTAR (Trade Mark) imaging system of the present applicant could have a focal length of 200mm and a speed f/1. Such a system would have the capability of detecting a 10 metre length craft side-on at a range of 10km where it would subtend an angle of 1mr (1 milliradian), this requiring the imaging detector to be constructed with pixels of 10 μ m pitch with the length of the craft fitting into a 20 pixel dimension.

Assuming further, that the imaging detector has dimensions of, for example, 7x9mm, then the angle field of view for 200mm focal length would be 2°x2.6°. Assuming a panorama width, for example, of 130° and a height of 20°, then a matrix of contiguous
5 images would require 10 rows of 50. For 10²m square pixels, each of the 500 images would be made up of 700x900 (equals 630000) pixels. The entire matrix would require 315Mb of RAM employed as video memory which, of course, would be readily available for this purpose.

10 In further embodiments of the invention, it is envisaged that there could, for example, be three imaging means with one looking at the whole scene, one scanning and one being used for specific focusing purposes.

It is further envisaged that the present invention could be utilised for aerial scanning,
15 rather than with the imaging means being land or sea based.

Where in the foregoing description, reference has been made to specific components or integers of the invention having known equivalents then such equivalents are herein incorporated as if individually set forth.

20 Although this invention has been described by way of example and with reference to possible embodiments thereof, it is to be understood that modifications or improvements may be made thereto without departing from the scope of the appended claims.

Claims

1. A surveillance system comprising:

(i) an imaging means;

(ii) means for scanning an area under surveillance with said imaging means so that a matrix of contiguous images are obtained;

(iii) means for detecting a first image within any of said contiguous images which may be inconsistent with an earlier collected first image; and

(iv) means enabling a specific focusing on an area proximate or corresponding to the first image.

2. A surveillance system as claimed in claim 1 where the imaging means comprises an ultra-fast high-resolution broad-spectrum long focal length imaging system.

3. A surveillance system as claimed in either claim 1 or 2 using at least two imaging means, a first of which is utilised for scanning the required area and the second of which is used for focusing on a specific image.

4. A method of providing surveillance for a required area including providing at least one imaging means which provides a matrix of contiguous images over the required area and further includes means for detecting a change in any one of said images requiring further investigation.

5. A surveillance system substantially as herein described and with reference to the figure.

6. A surveillance method substantially as herein described and with reference to the figure.

1/1

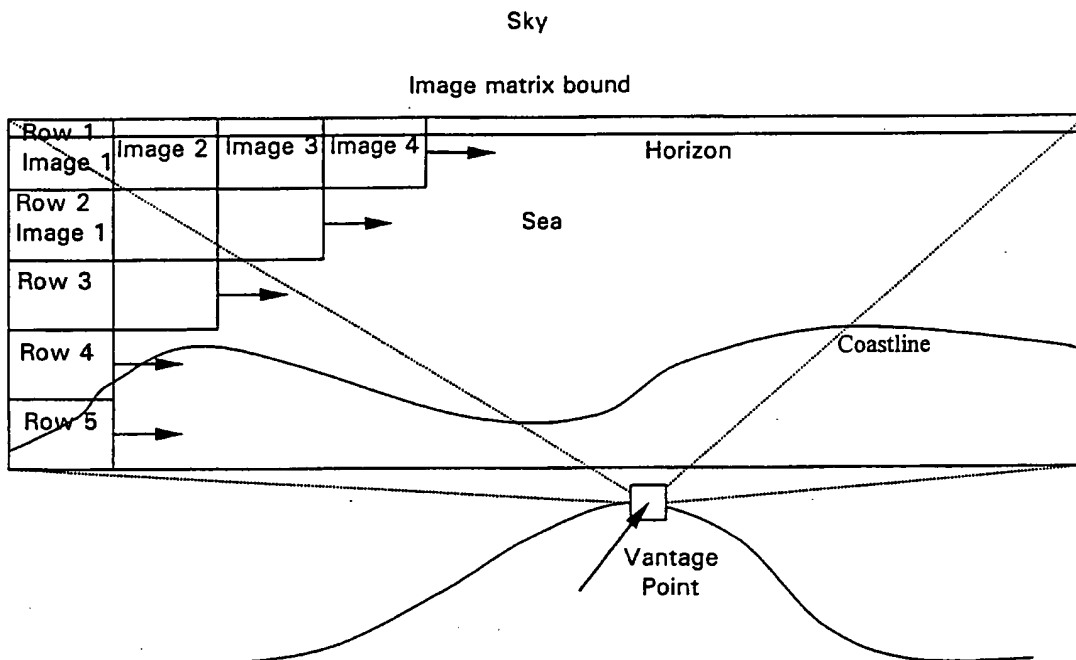


Fig 1.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ 98/00148

A. CLASSIFICATION OF SUBJECT MATTER																						
Int Cl ⁶ : G08B 13/194																						
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols) IPC: G08B 13/194, 13/196																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: IPC as above																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
X,Y	US 5666157 A (AVIV) 9 September 1997 Columns 4-7	1-6																				
X,Y	US 5581297 A (KOZ et al) 3 December 1996 Abstract, columns 5-7	1-6																				
X,Y	US 5151945 A (LEE et al) 29 September 1992 Abstract	1-6																				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex																						
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>earlier application or patent but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																			
"E"	earlier application or patent but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																			
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search 6 January 1999		Date of mailing of the international search report 19 JAN 1999																				
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929		Authorized officer PHILIP SPANN Telephone No.: (02) 6283 2178																				

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NZ 98/00148

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,Y	US 3686434 A (LEMELSON) 22 August 1972 Columns 2-10	1-6
X,Y	GB 2286042 A (SECURITY ENCLOSURES LIMITED) 2 August 1995 Pages 1-4, 12	1-6
X,Y	EP 298606 A (GEC-MARCONI LIMITED) 11 January 1989 Columns 4-6	1-6
X,Y	WO 93/18492 A (COMMONWEALTH OF AUSTRALIA) 16 September 1993 Pages 2-7, 10-11	1-6
Y	WO 95/34013 A (INDUSTRIAL RESEARCH LIMITED) 14 December 1995 Whole document	2

Information on patent family members

International application No.

PCT/NZ 98/00148

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5666157	WO	97/42764				
US	5581297	NONE					
US	5151945	NONE					
US	3686434	NONE					
GB	2286042	EP	665522	US	5572033		
EP	298606	GB	2207020	US	4952809		
WO	93/18492	AU	36234/93	EP	630510	US	5465080
WO	95/34013	AU	26847/95	AU	63796/98	CA	2192328
		EP	770224	NZ	287963		